

(12)特許協力条約に基づいて公開された国際出願

(19) 世界知的所有権機関  
国際事務局(43) 国際公開日  
2003年2月13日 (13.02.2003)

PCT

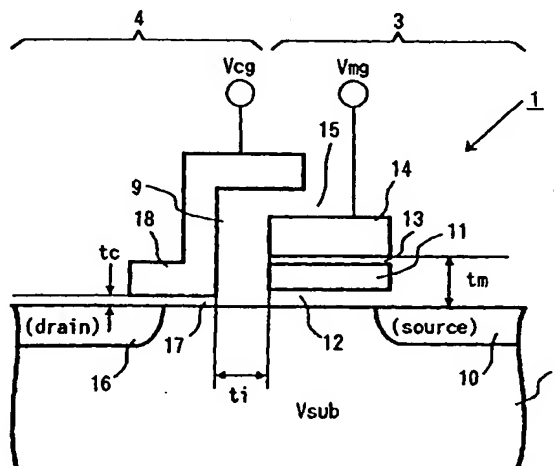
(10) 国際公開番号  
WO 03/012878 A1

- (51) 国際特許分類: H01L 29/788, 29/792, 27/115, 21/8247 (72) 発明者; および  
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- (21) 国際出願番号: PCT/JP02/07371
- (22) 国際出願日: 2002年7月22日 (22.07.2002)
- (25) 国際出願の言語: 日本語
- (26) 国際公開の言語: 日本語
- (30) 優先権データ:  
特願2001-227203 2001年7月27日 (27.07.2001) JP  
特願2001-228870 2001年7月30日 (30.07.2001) JP
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[続葉有]

(54) Title: SEMICONDUCTOR DEVICE

(54) 発明の名称: 半導体装置



(57) Abstract: A semiconductor device has nonvolatile memory cells (1), each of which comprising a MOS type first transistor section (3) used for information storage and a MOS type second transistor section (4) selecting a first transistor section. The second transistor section has a bit line electrode (16) connected to a bit line and a control gate electrode (18) connected to a control gate control line. The first transistor section has a source line electrode (10) connected to a source line, memory gate electrode (14) connected to a memory gate control line, and charge accumulating region (11) disposed just under the memory gate electrode. The gate dielectric strength of the second transistor section is lower than that of the first transistor section. When the thickness of the gate insulation film of the second transistor section is (tc) and that of the first transistor section is (tm), the relation of (tc)<(tm) holds.

[続葉有]

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/07371

## A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl<sup>7</sup> H01L29/788, 29/792, 27/115, 21/8247

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl<sup>7</sup> H01L29/788, 29/792, 27/115, 21/8247

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

|                           |           |                            |           |
|---------------------------|-----------|----------------------------|-----------|
| Jitsuyo Shinan Koho       | 1926-1996 | Jitsuyo Shinan Toroku Koho | 1996-2002 |
| Kokai Jitsuyo Shinan Koho | 1971-2002 | Toroku Jitsuyo Shinan Koho | 1994-2002 |

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                          | Relevant to claim No.                     |
|-----------|---|---|
| X<br>Y    | JP 5-82798 A (Fujitsu Ltd.),<br>02 April, 1993 (02.04.93),<br>Full text; Fig. 1<br>(Family: none)           | 72, 73, 76<br>1-8, 24-34,<br>36-39, 88-91 |
| X<br>Y    | US 6316317 B1 (NEC Corp.),<br>13 November, 2001 (13.11.01),<br>Full text<br>& JP 2000-269361 A<br>Full text | 71, 75<br>1-8, 24-34,<br>36-39, 77        |
| Y         | JP 2001-44395 A (NEC Corp.),<br>11 December, 2001 (11.12.01),<br>Full text<br>& US 6329247 B1               | 1-8, 24-34,<br>36-39                      |

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"P" document published prior to the international filing date but later than the priority date claimed

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"&amp;" document member of the same patent family

Date of the actual completion of the international search  
22 October, 2002 (22.10.02)Date of mailing of the international search report  
05 November, 2002 (05.11.02)Name and mailing address of the ISA/  
Japanese Patent Office

Authorized officer

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/07371

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages   | Relevant to claim No.  |
|-----------|--|--|
| Y         | JP 2001-15613 A (Sony Corp.),<br>19 January, 2001 (19.01.01),<br>Modes 3, 4; Figs. 4, 5<br>(Family: none)  | 7, 8, 48, 49,<br>51, 52, 54, 55,<br>57, 58, 60, 61,<br>63, 64, 66, 67            |
| Y         | JP 11-220044 A (Masaki OGURA),<br>10 August, 1999 (10.08.99),<br>Par. Nos. [0072] to [0073]; Figs. 6A, 6B<br>(Family: none)  | 27   |
| X         | US 2001/0000625 A1 (Kabushiki Kaisha Toshiba),<br>03 May, 2001 (03.05.01),   | 41-44, 50, 53,<br>56, 59   |
| Y         | Full text<br>& JP 11-31799 A<br>Full text  | 30-33, 40, 45,<br>46-49, 51, 52,<br>54, 55, 57, 58,<br>60-67, 74                 |
| X         | JP 11-177047 A (Hitachi, Ltd.),<br>02 July, 1999 (02.07.99),   | 41-44, 50, 53,<br>56, 59   |
| Y         | Full text<br>& US 2002/9851 A & US 2002/14641 A<br>& US 2002/19100 A   | 30-33, 40,<br>45-49, 51, 52,<br>54, 55, 57, 58,<br>60-67, 74                     |
| Y         | JP 61-172375 A (Kabushiki Kaisha Toshiba),<br>04 August, 1986 (04.08.86),<br>Full text; Figs. 5, 6<br>(Family: none)   | 34, 37   |
| Y         | JP 10-22404 A (Ricoh Co., Ltd.),<br>23 January, 1998 (23.01.98),<br>Full text; Figs. 2, 3<br>(Family: none)  | 40, 47-49, 51,<br>52, 54, 55, 57,<br>58, 60, 61, 63,<br>64, 66, 67, 74,<br>88-91 |
| X         | JP 3-228377 A (Toshiba Corp.),<br>09 October, 1991 (09.10.91),   | 68, 69<br>70   |
| Y         | Full text; Fig. 1<br>(Family: none)  |  |
| X         | JP 61-131484 A (Shingijutsu Kaihatsu Jigyodan),<br>19 June, 1986 (19.06.86),<br>Full text; Fig. 1<br>(Family: none)  | 78   |
| Y         | JP 56-135973 A (Hitachi, Ltd.),<br>23 October, 1981 (23.10.81),<br>Full text<br>(Family: none)   | 84-87  |
| Y         | T.Y. LUO et al., Effect of H2 Content on Reliability<br>of Ultrathin In-Situ Steam Generated (ISSG) SiO2,<br>IEEE Electron Device Letters, Vol.21, No.9, September<br>2000, pages 430 to 432 | 88-91  |

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/07371

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages   | Relevant to claim No. |
|-----------|--|-----------------------|
| A         | JP 9-326487 A (Hitachi, Ltd.),<br>16 December, 1997 (16.12.97),<br>Par. No. [0028]<br>(Family: none)   | 79-83                 |
| A         | JP 1-133364 A (Matsushita Electronics Corp.),<br>25 May, 1989 (25.05.89),<br>Page 2, upper right column to lower left column<br>(Family: none) | 79-83                 |

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/07371

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

The inventions of claims 1-23, 24-39 relate to the gate dielectric strengths of first and second MOS transistors which constitute memory cells.  
The inventions of claims 40-67, 74, 86, 87, 91 relate to the thickness of the gate insulation film of the second MOS transistor and that of another MOS transistor which constitute memory cells.  
The invention of claim 68 relates to the dielectric strength of the diffusion junction between the first MOS transistor and the second transistor which constitute memory cells.  
(continued to extra sheet)

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
  
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/07371

Continuation of Box No.II of continuation of first sheet(1)

The inventions of claims 69, 70 relate to the structure of the diffusion layer of the second MOS transistor and that of another MOS transistor which constitute memory cells.

The inventions of claims 71, 75 relate to the charge neutral threshold value of first and second MOS transistors which constitute memory cells.

The inventions of claims 72, 73, 76, 77 relate to the channel impurity concentrations of the first and second MOS transistors which constitute memory cells.

The invention of claim 78 relates to the intergate distance, the distance between the gate and the storage holding regions of first and second MOS transistors which constitute memory cells.

The inventions of claims 79-83 relate to the gate oxide film of the second MOS transistor and the intergate insulation film of the first and second MOS transistors.

The inventions of claims 84, 85 relates to a semiconductor nonvolatile device having a nitride film with the function of locally holding charges formed by heat treatment in a hydrogen atmosphere.

The inventions of claims 88, 89 relate to the intergate insulation film of the first and second MOS transistors which constitute memory cells.

The invention of claim 90 relates to the gate insulation film of the first MOS transistor which constitutes a memory cell.

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